Patent claims:

1. A nanofiller,
having a (particle) size of less than 20 nm and comprising functionalized polyhedral oligomeric silicon-oxygen cluster units of the formula

$$[(R_aX_bSiO_{1.5})_m\ (R_cX_dSiO)_n\ (R_eX_fSi_2O_{2.5})_o\ (R_gX_hSi_2O_2)_p]$$

with:
a, b, c = 0-1; d = 1-2; e, g, f = 0-3; h = 1-4;
$m \cdot b + n \cdot d + o \cdot f + p \cdot h \leq 4$; $m+n+o+p \geq 4$; $a+b = 1$; $c+d = 2$; $e+f = 3$ and $g+h = 4$;
R = hydrogen atom, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, cycloalkynyl, aryl, heteroaryl group or polymer unit, which are in each case substituted or unsubstituted, or further functionalized polyhedral oligomeric silicon-oxygen cluster units, which are attached by way of a polymer unit or a bridging unit,
X = oxy, hydroxyl, alkoxy, carboxyl, silyl, alkylsilyl, alkoxysilyl, siloxy, alkylsiloxy, alkoxysiloxy, silylalkyl, alkoxysilylalkyl, alkylsilylalkyl, halogen, epoxy, ester, fluoroalkyl, isocyanate, blocked isocyanate, acrylate, methacrylate, nitrile, amino, phosphine group or substituents of the type **R** containing at least one such group of the type **X**,
the substituents of the type **R** being identical or different and the substituents of the type **X** being identical or different, with the proviso that there are not more than four substituents of the type **X** per cluster unit.

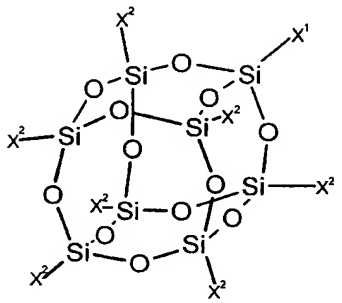
2. The nanofiller as claimed in claim 1,
having a (particle) size of less than 6 nm.

3. The nanofiller as claimed in claim 1 or 2,
entering into at least one chemical bond with a matrix.

4. The nanofiller as claimed in at least one of claims 1 to 3,
wherein

the cluster unit contains substituents of the type **X** which are different.

5. The nanofiller as claimed in at least one of claims 1 to 4,
wherein
the functionalized polyhedral oligomeric silicon-oxygen cluster unit is based on the structure **1**



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with $\mathbf{X^1}$ = substituent of type **X** or **–O-SiX$_3$**, $\mathbf{X^2}$ = substituent of type **X**, **–O-SiX$_3$**, **–O-SiX$_2$R**, **R**, **–O-SiXR$_2$** or **–O-SiR$_3$**, with the proviso that there are not more than four groups of the type **X** per cluster unit.

6. The nanofiller as claimed in at least one of claims 1 to 4,
comprising functionalized polyhedral oligomeric silicon-oxygen cluster units of the formula

$$[(R_aX_bSiO_{1.5})_m\ (R_cX_dSiO)_n\ (R_eX_fSi_2O_{2.5})_o\ (R_gX_hSi_2O_2)_p]$$

with:
a, b, c = 0-1; d = 1-2; e, g = 0-3; f = 0-2; h = 1-2;
$m\cdot b + n\cdot d + o\cdot f + p\cdot h \leq 2$; $m+n+o+p \geq 4$; $a+b = 1$; $c+d = 2$; $e+f = 3$ and $g+h = 4$;
R = hydrogen atom, alkyl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, cycloalkynyl, aryl, heteroaryl group or polymer unit, which are in each case substituted or unsubstituted or further functionalized polyhedral oligomeric silicon-oxygen cluster units, which are attached by way of a polymer unit or a bridging unit,

X = oxy, hydroxyl, alkoxy, carboxyl, silyl, alkylsilyl, alkoxysilyl, siloxy, alkylsiloxy, alkoxysiloxy, silylalkyl, alkoxysilylalkyl, alkylsilylalkyl, halogen, epoxy, ester, fluoroalkyl, isocyanate, blocked isocyanate, acrylate, methacrylate, nitrile, amino, phosphine group or substituents of the type **R** containing at least one such group of the type **X**,

the substituents of the type **R** being identical or different and the substituents of the type **X** being identical or different, with the proviso that there are not more than two substituents of the type **X** per cluster unit.

7. The nanofiller as claimed in any of claims 1 to 6,
wherein
the substituent of type **X** contains an amino group.

8. The nanofiller as claimed in any of claims 1 to 7,
wherein
the substituent of type **X** contains an isocyanate group or a blocked isocyanate group.

9. The nanofiller as claimed in any of claims 1 to 8,
wherein
the substituent of type **X** contains a hydroxyl group.

10. The nanofiller as claimed in any of claims 1 to 9,
wherein
the substituent of type **X** contains an alkoxysilyl, siloxy, alkylsiloxy, alkoxysiloxy or alkoxysilylalkyl group.

11. The nanofiller as claimed in any of claims 1 to 10,
wherein
the substituent of type **X** contains an epoxy group.

12. The nanofiller as claimed in any of claims 1 to 11,
wherein

the substituent of type **X** contains a vinylic group.

13. The nanofiller as claimed in any of claims 1 to 12,
wherein
the substituent of type **X** contains a carboxyl or primary or secondary amino group.

14. The nanofiller as claimed in at least one of claims 1 to 13,
having a molecular weight of at least 400 g/mol.

15. The nanofiller as claimed in at least one of claims 1 to 14,
wherein
the functionalized polyhedral oligomeric silicon-oxygen cluster unit is a functionalized oligomeric silasesquioxane unit.

16. The nanofiller as claimed in claim 15,
wherein
the silasesquioxane unit has a functionalized homoleptic structure, all substituents of type **R** being identical.

17. The nanofiller as claimed in claim 15,
wherein
the silasesquioxane unit has a functionalized heteroleptic structure, at least two of the substituents of type **R** being different.

18. The nanofiller as claimed in at least one of claims 15 to 17,
wherein
the functionalized oligomeric silasesquioxane unit is obtained by reacting silasesquioxane units having free hydroxyl groups with monomeric functionalized silanes of the structure $Y_3Si\text{-}X^1$, $Y_2SiX^3X^4$, and $YsiX^3X^4X^5$,
the substituent **Y** being a leaving group selected from alkoxy, carboxyl, halogen, silyloxy, and amino groups, and

the substituents X^3, X^4 and X^5 are of the type **X** or **R** are identical or different, with the proviso that for each silasesquioxane unit obtained there are at most one or two substituents of the type **X** per cluster unit.

19. The nanofiller as claimed in at least one of claims 1 to 14,
wherein
the functionalized polyhedral oligomeric silicon-oxygen cluster unit is a functionalized oligomeric spherosilicate unit.

20. The nanofiller as claimed in at least one of claims 1 to 19,
wherein
there is not more than one substituent of the type **X** per cluster unit.

21. A matrix comprising a nanofiller as claimed in any of claims 1 to 20,
which comprises a nanofiller bonded covalently by a chemical reaction to an organic and/or inorganic matrix material.

22. The matrix as claimed in claim 21,
which comprises as inorganic matrix material, mineral building materials and/or inorganic sinter compositions.

23. The matrix as claimed in claim 21 or 22,
which comprises as organic matrix material an elastomer or a thermoplastic or thermoset.

24. The matrix as claimed in at least one of claims 21 to 23,
wherein
the organic matrix material is a plastic or polymer selected from polyethylene, polypropylene, polyester, copolyester, polycarbonate, polyamide, copolyamide, polyurethane, polyacrylate, polymethacrylate, polymethacrylate copolymer, polysiloxane, polysilane, polytetrafluoroethylene, phenolic resin, polyoxymethylene, epoxy resin, polyvinyl chloride, vinyl chloride copolymer, polystyrene, styrene copolymers, ABS polymer, alkyd resin, unsaturated polyester resin, nitrocellulose resin, and rubber.

25. The matrix as claimed in at least one of claims 21 to 24,
wherein
the matrix contains from 0.05 to 90% by weight of the nanofiller.

26. A process for preparing a matrix as claimed in any of claims 21 to 25,
which comprises mixing the nanofiller into a matrix material which is in liquid form and forming by chemical reaction at least one covalent bond between nanofiller and matrix material.

27. The process as claimed in claim 26,
wherein
the nanofiller is mixed mechanically on mass into a polymer melt.

28. The process as claimed in claim 26,
wherein
before being mixed into the matrix material the nanofiller is dissolved in a solvent.

29. The use of a nanofiller as claimed or set forth in at least one of claims 1 to 20 for producing plastics, sealing compounds, paints, printing inks, adhesives, ceramics, mineral building materials, concrete, mortar, plaster, and coatings of ceramics and plastics.